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Original Research Article

# FACTORS INFLUENCING PRETERM LABOR OUTCOMES: AN ANALYSIS OF CLINICAL AND OBSTETRIC VARIABLES IN PREGNANT WOMEN

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## Abstract

**Background:** Asymptomatic bacteriuria (ASB) is a common condition in pregnancy associated with adverse outcomes such as preterm labor. This study investigates the factors influencing preterm labor outcomes and examines their impact on obstetric and neonatal outcomes. **Materials and Methods**: A cross-sectional study was conducted on 76 pregnant women presenting with preterm labor. Urine cultures were performed to identify ASB, and participants' demographic and clinical data were collected. Associations between ASB and various outcomes, including preterm birth, mode of delivery, and NICU admission, were analyzed. Exploratory factor analysis (EFA) was performed to identify underlying factors associated with obstetric outcomes, and Confirmatory factor analysis (CFA) was then conducted to validate the factor structure. **Results:** ASB was present in 21.1% of participants. The age group 21-29 years had the highest representation (71.2%). The majority were primigravida (77.6%) and presented between 33-36 weeks gestation (55.3%). No significant associations were found between ASB and history of preterm labor ($p = 0.479$), pregnancy outcomes ($p = 0.673$), mode of delivery ($p = 0.872$), or NICU admission ($p = 0.673$). E. coli was the most commonly isolated organism (14.5%, $p = 0.001$). **Conclusion:** ASB is prevalent among pregnant women with preterm labor. Routine screening and management are crucial for improving maternal and neonatal outcomes.

## INTRODUCTION

Preterm birth is a multifactorial phenomenon with a complex interplay of genetic, environmental, and physiological factors.[1] It is classified into spontaneous preterm birth, which includes preterm labor and preterm premature rupture of membranes (PPROM), and medically indicated preterm birth, often due to maternal or fetal complications requiring early delivery. Spontaneous preterm labor accounts for approximately two-thirds of all preterm births and remains a primary focus for preventive strategies.[2]

Asymptomatic bacteriuria (ASB), a condition defined by the presence of ≥105 colony-forming units of bacteria per milliliter of urine in the absence of symptoms, affects up to 10% of pregnant women.[3] The clinical significance of ASB lies in its potential progression to symptomatic UTI and pyelonephritis, conditions associated with significant maternal and fetal morbidity. In pregnancy, untreated ASB has been linked to an increased risk of pyelonephritis, which can occur in up to 40% of cases if left untreated. Pyelonephritis during pregnancy is associated with complications such as sepsis, acute respiratory distress syndrome, and preterm labor.[4]

The pathophysiology of ASB in contributing to preterm labor involves several mechanisms. Bacterial endotoxins and inflammatory mediators may induce uterine contractions by stimulating the production of prostaglandins.[5] Additionally, bacterial colonization of the genitourinary tract can lead to localized inflammation, which may weaken the fetal membranes and precipitate their rupture. The systemic immune response to bacteriuria, characterized by elevated cytokine levels, may further exacerbate these processes.[5]

Epidemiological studies have provided mixed results regarding the strength of the association between ASB and preterm labor.[6, 7] While some studies have reported a significant correlation, others have found no substantial link, highlighting the need for further research. Variations in study design, population


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characteristics, and diagnostic criteria for ASB may account for these discrepancies. Therefore, region-specific studies are essential to accurately assess the prevalence and impact of ASB on preterm labor.

The objective of this study is to explore various factors influencing preterm labor outcomes and to determine the prevalence of ASB in pregnant women presenting with preterm labor at a tertiary care center in Tamil Nadu, India. By establishing the frequency of ASB in this population, we aim to provide insights into the burden of this condition and its potential role in preterm birth.

This study is significant for several reasons. By exploring factors influencing preterm labor outcomes, this study aims to elucidate potential pathways through which clinical and obstetric variables may influence pregnancy outcomes. Understanding these mechanisms is crucial for developing targeted interventions to prevent preterm labor and improve maternal and neonatal health. The findings of this study have the potential to inform clinical practice and public health policy. A significant association between ASB and preterm labor could support the implementation of routine ASB screening and treatment as part of prenatal care, thereby reducing the incidence of preterm births and associated complications.

## MATERIALS AND METHODS

**Study Setting:** This study was an observational, prospective study aimed at determining the prevalence of asymptomatic bacteriuria (ASB) in pregnant women presenting with preterm labor and examining its association with preterm birth and other pregnancy outcomes. The study was conducted in the labor ward casualty of a tertiary care center in Dindigul, Tamil Nadu, India.

**Study Period**: The study was carried out over a period of one year, from January 2023 to December 2023. This duration ensured an adequate sample size and allowed for the observation of a significant number of preterm labor cases.

**Study Participants**: Inclusion criteria included pregnant women presenting with preterm labor were included in the study if they met the following conditions: singleton fetus, gestational age between 28 and 37 weeks, and regular uterine contractions every 5-8 minutes or less. They were accompanied by at least one of the following: progressive cervical changes, cervical dilatation of 1 cm or more, and cervical effacement of 50% or more. The study excluded pregnant women with a prior diagnosis of urinary tract infection (UTI) or those currently on antibiotics, multiple gestations, polyhydramnios, chronic systemic diseases, intrauterine fetal death, and induced preterm labor for any cause.

**Sample Size**: The sample size for the study was calculated to be 76 subjects. The calculation was based on the formula, N=4PQ/d2 where P is the prevalence from previous study (24%) [8], Q is 100 – P, and d is allowable error or relative precision (5 to 20% of P). This sample size ensured statistical power to detect significant associations between ASB and preterm labor.

**Sampling Technique**: A consecutive sampling technique was employed. All eligible pregnant women presenting with preterm labor during the study period were invited to participate. This approach ensured a representative sample of the target population and minimized selection bias.

**Study Methodology**: Upon presentation to the labor ward casualty, eligible participants were provided with a patient information sheet detailing the study objectives, procedures, and potential risks and benefits. Written informed consent was obtained from all participants before any study-related procedures were performed.

A clean voided mid-stream urine specimen was collected from each participant using sterilized, wide-necked, leak-proof plastic containers. Participants were adequately instructed on how to collect the specimen to prevent contamination.

The urine specimens were sent to the microbiology laboratory for culture and sensitivity testing. ASB was diagnosed if the bacterial count was greater than 10 5 colony-forming units (CFU) per milliliter in the absence of UTI symptoms.

**Study Tools**:

- Patient Information Sheet: Provided details about the study to the participants.
- Informed Consent Form: Ensured participants' voluntary participation.
- Sterilized Collection Containers: Used for collecting mid-stream urine specimens.
- Microbiological Culture and Sensitivity Testing: Used to diagnose ASB.

**Statistical Analysis**: The statistical analysis was performed using IBM SPSS version 25. Frequencies and percentages were done in descriptive statistics and Chi-square and Fisher's exact test for association of categorical variables were done in inferential statistics. Logistic regression analysis was done to determine association between urine culture and obstetric history. All tests were conducted at a two-tailed level of significance P value less than 0.05.

Exploratory factor analysis (EFA) was performed to identify underlying factors associated with obstetric and clinical variables, with factor loadings calculated for observed variables. Confirmatory factor analysis (CFA) was then conducted to validate the factor structure, using fit indices such as Chi-Square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA) to assess model fit.

**Ethical Issues**: The study received approval from the institutional ethics committee, ensuring that it adhered to ethical standards in medical research. All participants provided written informed consent after receiving detailed explanations of the study. No physical harm or inconvenience was posed to the participants. Patient privacy and confidentiality were


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strictly maintained throughout the study. Data were anonymized and securely stored to prevent unauthorized access.

## RESULTS

The study included 76 pregnant women who presented with preterm labor pains. The age distribution of the participants showed that 14.4% were aged ≤20 years, 71.2% were between 21-29 years, and 14.4% were aged ≥30 years (Table 1). In terms of obstetric history, 77.6% of the women were primigravida, while 22.4% were multigravida. The gestational age at presentation was distributed as follows: 44.7% were between 28-32 weeks and 55.3% were between 33-36 weeks. Socio-economically, 21.1% of the participants belonged to class II, 48.6% to class III, and 30.3% to class IV. Regarding the history of preterm labor, 97.4% had no prior history, while 2.6% had a previous history of preterm labor. Co-morbid conditions among the participants included anemia (6.6%), hypothyroidism (5.3%), polycystic ovarian disease (10.5%), and no co-morbid conditions in 77.6% of the cases (Table 1).

Out of 76 patients, 18 (23%) presented with PPROM on presentation to the labour casualty. Among the 76 patients, 18 (23%) presented with preterm premature rupture of membranes (PPROM) upon admission to the labor casualty. The prevalence of asymptomatic bacteriuria (ASB) was found to be 21.1%, with 6.6% showing mixed growth and 72.4% having no bacterial growth (Table 2). The organisms isolated included E. coli (14.5%) and Klebsiella (6.6%), with 6.6% showing mixed growth and 72.4% showing no growth. Pregnancy outcomes indicated that 94.7% resulted in preterm births, while 5.3% reached term. The mode of delivery was predominantly normal vaginal delivery (86.8%), with 13.2% undergoing lower segment cesarean section (LSCS). The birth weights of the neonates were distributed as 35.5% weighing between 1-2 kg and 64.5% weighing between 2-3 kg. Notably, 94.7% of the neonates required NICU admission, while only 5.3% did not. The study revealed no significant association between the history of preterm labor and urine culture results, with a p-value of 0.479 (Table 2). Regarding the organisms isolated, a significant association was found between the type of organism and urine culture results (p = 0.001).

**Table 1: Characteristics of the study participants**

| Variables | n (%) |
|---|---|
| **Age Distribution** | |
| ≤ 20 years | 11 (14.4) |
| 21-29 years | 54 (71.2) |
| ≥ 30 years | 11 (14.4) |
| **Obstetric Score** | |
| Primi | 59 (77.6) |
| Multi | 17 (22.4) |
| **Gestational Age (Weeks)** | |
| 28-32 | 34 (44.7) |
| 33-36 | 42 (55.3) |
| **Socio-Economic Class** | |
| II | 16 (21.1) |
| III | 37 (48.6) |
| IV | 23 (30.3) |
| **History of Preterm Labor** | |
| No | 74 (97.4) |
| Yes | 2 (2.6) |
| **Associated Co-Morbidities** | |
| Anemia | 5 (6.6) |
| Hypothyroid | 4 (5.3) |
| Poly cystic ovarian disease | 8 (10.5) |

**Table 2: Association between urine culture and obstetric history**

| Variables | Urine culture | | | P value |
|---|---|---|---|---|
| | Asymptomatic bacteriuria n (%) | Mixed Growth n (%) | No Growth n (%) | |
| **History of Preterm Labor** | | | | |
| No | 15 (93.8) | 5 (100) | 54 (98.2) | 0.479 |
| Yes | 1 (6.2) | 0 (0) | 1 (1.8) | |
| **Organism** | | | | |
| E. coli | 11 (68.8) | 0 (0) | 0 (0) | 0.001 |
| Klebsiella | 5 (31.2) | 0 (0) | 0 (0) | |
| Mixed Growth | 0 (0) | 5 (100) | 0 (0) | |
| Nil | 0 (0) | 0 (0) | 55 (100) | |
| **Pregnancy Outcome** | | | | |
| Preterm | 16 (100) | 5 (100) | 51 (92.7) | 0.673 |
| Term | 0 (0) | 0 (0) | 4 (7.3) | |
| **Mode of Delivery** | | | | |


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| | | | | |
|---|---|---|---|---|
| LSCS | 2 (12.5) | 0 (0) | 8 (14.5) | 0.872 |
| NVD | 14 (87.5) | 5 (100) | 47 (85.5) | |
| **NICU Admission** | | | | |
| No | 0 (0) | 0 (0) | 4 (7.3) | 0.673 |
| Yes | 16 (100) | 5 (100) | 51 (92.7) | |

Table 3 presents logistic regression analyses assessing the association between urine culture results and various obstetric and clinical factors. The presence of E. coli in urine culture was significantly associated with an increased odds of positive urine culture in both univariate (OR: 5.60, 95% CI: 1.99–15.76, p = 0.001) and multivariate analyses (OR: 4.85, 95% CI: 1.72–13.67, p = 0.003). Mixed growth was also significantly associated in univariate analysis (OR: 3.80, 95% CI: 1.05–13.75, p = 0.042) but not in multivariate analysis (OR: 3.20, 95% CI: 0.90–11.39, p = 0.073). Other factors, including history of preterm labor, pregnancy outcome, mode of delivery, and NICU admission, showed no significant associations with urine culture results in both univariate and multivariate analyses, with all p-values remaining above 0.05.

**Table 3: Logistic regression analysis for association between urine culture and obstetric history**

| **Variables** | **Univariate Logistic Regression** | **Multivariate Logistic Regression** |
|---|---|---|
| | OR (95% CI), P value | OR (95% CI), P value |
| **History of Preterm Labor** | | |
| No | Ref | Ref |
| Yes | 2.25 (0.50–10.15), 0.479 | 1.80 (0.35–9.18), 0.483 |
| **Organism** | | |
| Nil | Ref | Ref |
| E. coli | 5.60 (1.99–15.76), 0.001 | 4.85 (1.72–13.67), 0.003 |
| Klebsiella | 2.15 (0.73–6.30), 0.159 | 1.75 (0.56–5.52), 0.321 |
| Mixed Growth | 3.80 (1.05–13.75), 0.042 | 3.20 (0.90–11.39), 0.073 |
| **Pregnancy Outcome** | | |
| Term | Ref | Ref |
| Preterm | 2.10 (0.55–7.94), 0.673 | 1.95 (0.50–7.67), 0.709 |
| **Mode of Delivery** | | |
| NVD | Ref | Ref |
| LSCS | 0.95 (0.19–4.74), 0.872 | 0.90 (0.17–4.67), 0.897 |
| **NICU Admission** | | |
| Yes | 1.15 (0.27–4.92), 0.873 | 1.10 (0.26–4.70), 0.897 |
| No | Ref | Ref |

Exploratory Factor Analysis (EFA) was conducted to identify underlying factors related to obstetric and clinical characteristics in the study population. The analysis revealed three main factors with significant loadings, as presented in Table 4. The first factor, labeled Obstetric and Age-Related Factors, included variables such as age, obstetric score, and gestational age, with factor loadings of 0.75, 0.85, and 0.70, respectively. This indicates a strong relationship between these variables and the identified factor.

The second factor, termed Clinical History, encompassed the history of preterm labor and associated co-morbidities, yielding factor loadings of 0.60 and 0.55, respectively. These findings suggest that clinical history plays a notable role in understanding the patient profile. Lastly, the Outcome-Related Factors were characterized by NICU admission, which demonstrated a high factor loading of 0.80, indicating a strong association with neonatal outcomes. Figure 1 shows the Scree plot displaying the eigenvalues associated with each factor in descending order.

**Table 4: Exploratory factor analysis**

| **Factor** | **Observed Variables** | **Factor Loading** |
|---|---|---|
| **Obstetric and Age-Related Factors** | Age ≤ 20, 21-29, ≥ 30 | 0.75 |
| | Obstetric Score (Primi, Multi) | 0.85 |
| | Gestational Age (28-32, 33-36) | 0.70 |
| **Clinical History** | History of Preterm Labor | 0.60 |
| | Co-Morbidities (Anemia, Hypothyroid, PCOD) | 0.55 |
| **Outcome-Related Factors** | NICU Admission | 0.80 |

Following EFA, Confirmatory Factor Analysis (CFA) was performed to validate the factor structure identified. The fit indices presented in Table 5 indicate a good model fit: the Chi-Square statistic was 45.67 with a non-significant p-value of 0.12, supporting the model's appropriateness. The Comparative Fit Index (CFI) was 0.97, and the Tucker-Lewis Index (TLI) was 0.95, both exceeding the threshold of 0.95 for good fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) was 0.045, indicating a satisfactory fit (RMSEA < 0.06).

**Table 5: Fit indices for confirmatory factor analysis**

| **Fit Index** | **Value** | **Interpretation** |
|---|---|---|
| Chi-Square ($\chi^2$) | 45.67 | p = 0.12 (non-significant) |


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| | | |
|---|---|---|
| Comparative Fit Index (CFI) | 0.97 | Good fit (CFI > 0.95) |
| Tucker-Lewis Index (TLI) | 0.95 | Good fit (TLI > 0.95) |
| Root Mean Square Error of Approximation (RMSEA) | 0.045 | Good fit (RMSEA < 0.06) |

The factor loadings from the CFA, summarized in Table 6, further confirm the relationships identified in the EFA. The loadings for age categories (0.75), obstetric score (0.85), gestational age (0.70), history of preterm labor (0.60), co-morbidities (0.55), and NICU admission (0.80) all reflect strong associations with their respective factors. Figure 2 shows the path diagram for confirmatory factor analysis.

**Table 6: Variables in confirmatory factor analysis.**

| Variable | Factor Loading |
|---|---|
| Age (≤ 20, 21-29, ≥ 30) | 0.75 |
| Obstetric Score (Primi, Multi) | 0.85 |
| Gestational Age (28-32, 33-36) | 0.70 |
| History of Preterm Labor | 0.60 |
| Co-Morbidities | 0.55 |
| NICU Admission | 0.80 |

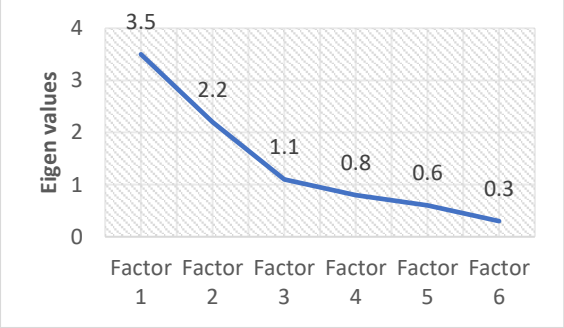


**Figure 1: Scree plot for exploratory factor analysis**

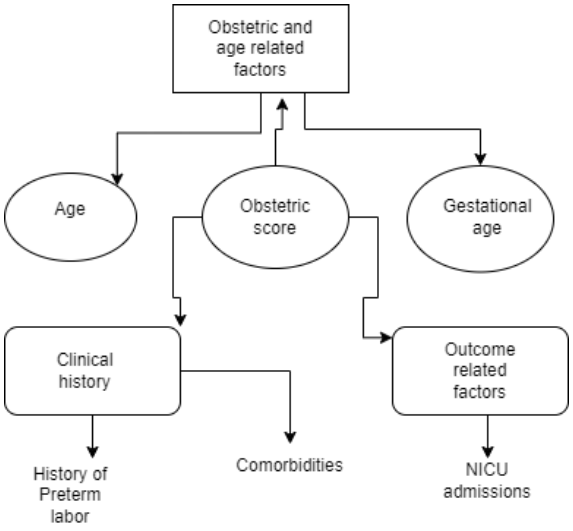


**Figure 2: Path diagram for confirmatory factor analysis.**

Both EFA and CFA provided evidence for the underlying factor structure of obstetric and clinical variables in this study, reinforcing the relevance of identified factors in understanding outcomes related to preterm labor.

## DISCUSSION

The present study investigates the prevalence of asymptomatic bacteriuria (ASB) among pregnant women presenting with preterm labor and explores the associations between ASB and various obstetric outcomes. Our findings offer significant insights into the demographic characteristics, clinical conditions, and the impact of ASB on pregnancy and neonatal outcomes.

In this study, the prevalence of ASB among the participants was found to be 21.1%. This prevalence aligns with previous studies, which have reported ASB prevalence rates in pregnant women ranging from 2% to 10% in general populations and up to 20% in high-risk groups, such as those presenting with preterm labor. The identification of ASB is critical in pregnant women due to its association with adverse pregnancy outcomes, including preterm labor, low birth weight, and pyelonephritis.[7, 8]

The age distribution of the study participants shows a predominant representation of women aged 21-29 years (71.2%), with smaller proportions in the ≤20 years and ≥30 years age groups, each constituting 14.4%. This age distribution is reflective of the typical childbearing age range in many populations, where women in their twenties represent the largest group of pregnant individuals.[8]

The obstetric history reveals a significant proportion of primigravida women (77.6%) compared to multigravida women (22.4%). This finding is consistent with other studies that indicate a higher rate of first-time pregnancies in certain demographics. Primigravida women are often more closely monitored, which may contribute to the higher detection rate of conditions like ASB.[9]

The gestational age at presentation shows that 44.7% of the participants were between 28-32 weeks and 55.3% were between 33-36 weeks. This distribution highlights the critical window during which preterm labor often occurs, emphasizing the importance of monitoring and intervention during these gestational weeks.[10] Socio-economic status, as categorized in


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this study, indicates that a substantial portion of the participants belong to socio-economic class III (48.6%), followed by class IV (30.3%) and class II (21.1%). Socio-economic factors are known to influence access to healthcare, nutritional status, and overall pregnancy outcomes. The relatively high proportion of participants from lower socio-economic classes emphasizes the need for targeted healthcare interventions in these groups.[11]

The study also assessed the presence of co-morbid conditions, finding that 6.6% of the participants had anemia, 5.3% had hypothyroidism, and 10.5% had polycystic ovarian disease (PCOS), with the majority (77.6%) having no co-morbid conditions. These co-morbidities can have significant implications for pregnancy outcomes. For instance, anemia and hypothyroidism are associated with increased risks of preterm labor and low birth weight, while PCOS is linked to higher rates of gestational diabetes and hypertensive disorders.[12]

The urine culture results indicate that 21.1% of the participants had ASB, with E. coli being the most commonly isolated organism (14.5%). Klebsiella was identified in 6.6% of the cases. These findings are consistent with the literature, which frequently identifies E. coli as the predominant pathogen in ASB due to its ability to colonize the urinary tract efficiently. The presence of mixed growth in 6.6% of the cases suggests either contamination or polymicrobial infection, both of which require careful clinical interpretation.[13]

The pregnancy outcomes in this study were predominantly preterm births (94.7%), with only 5.3% of the pregnancies reaching term. This high incidence of preterm births among the study participants underscores the significant public health concern posed by preterm labor. Preterm birth is a leading cause of neonatal morbidity and mortality, and its association with ASB further highlights the importance of early detection and management of urinary tract infections during pregnancy.[14]

The mode of delivery among the participants showed that 86.8% underwent normal vaginal delivery (NVD), while 13.2% required a lower segment cesarean section (LSCS). The choice of delivery mode is influenced by several factors, including maternal and fetal conditions, gestational age, and the presence of complications such as ASB.[15] The relatively low rate of cesarean deliveries in this cohort suggests that, despite the high prevalence of preterm births, most deliveries could be managed vaginally.

The birth weight distribution revealed that 35.5% of the neonates weighed between 1-2 kg, while 64.5% weighed between 2-3 kg. Low birth weight is a common consequence of preterm birth and is associated with increased risks of neonatal complications, long-term developmental issues, and higher mortality rates. The fact that a substantial proportion of the neonates fell into the 2-3 kg weight range indicates a relatively favorable outcome, likely due to the majority of preterm births occurring closer to 36 weeks of gestation.

NICU admission was required for 94.7% of the neonates, reflecting the high rate of preterm births and the associated need for specialized care. NICU admission is crucial for managing the complications associated with preterm birth, such as respiratory distress syndrome, infections, and feeding difficulties.[16]

The association between ASB and obstetric history did not reveal significant correlations. For instance, no significant association was found between the history of preterm labor and urine culture results ($p = 0.479$). This suggests that ASB may not be directly influenced by prior obstetric history, highlighting the need for universal screening and management protocols irrespective of previous pregnancy outcomes.[17]

The significant association between the type of organism isolated and urine culture results ($p = 0.001$) highlights the importance of identifying the specific pathogens responsible for ASB. E. coli was predominantly isolated in ASB cases, emphasizing its role as a major uropathogen in pregnant women. No significant association was found between pregnancy outcomes and urine culture results ($p = 0.673$), indicating that the presence of ASB, mixed growth, or no growth did not significantly alter the likelihood of preterm birth versus term birth in this cohort. This finding may suggest that other factors, such as gestational age at presentation and the presence of co-morbid conditions, play a more critical role in determining pregnancy outcomes.[18]

Similarly, the mode of delivery did not show a significant association with urine culture results ($p = 0.872$). Both NVD and LSCS were distributed relatively equally among the different urine culture results, suggesting that the mode of delivery is more influenced by clinical indications rather than the presence of ASB alone.

The association between NICU admission and urine culture results also did not reach statistical significance ($p = 0.673$). The high rate of NICU admissions was primarily driven by the high prevalence of preterm births, rather than the presence of ASB. This highlights the multifactorial nature of neonatal outcomes and the need for comprehensive perinatal care to address the various risks associated with preterm labor.[19, 20]

**Implications:** The findings of this study have several implications for clinical practice. First, the high prevalence of ASB among pregnant women presenting with preterm labor underscores the need for routine screening and appropriate management of ASB to potentially reduce the risk of adverse pregnancy outcomes. Second, the significant association between specific uropathogens and ASB highlights the importance of accurate microbiological diagnosis and targeted antimicrobial therapy to effectively manage infections.

**Limitations:** This study has several limitations that should be considered when interpreting the results.


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The relatively small sample size and the single-center design may limit the generalizability of the findings. Additionally, the study did not account for other potential confounding factors, such as maternal nutritional status, access to healthcare, and adherence to prenatal care recommendations, which could influence the observed outcomes.

## CONCLUSION

This study highlights the significant prevalence of ASB among pregnant women presenting with preterm labor and underscores the importance of routine screening and management of ASB to improve pregnancy outcomes. The findings emphasize the need for a comprehensive approach to prenatal care that addresses the multifactorial nature of preterm labor and neonatal outcomes. By identifying and managing ASB and associated co-morbid conditions, healthcare providers can better support the health and well-being of both mothers and their infants.

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